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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/799,961
Filing Date: March 12, 2004
Appellant(s): HOFFMAN ET AL.

Steven L. Nichols
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 8/1/2008 appealing from the Office action mailed 4/11/2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

Japanese Patent No. JP405251705A	Hamada et al.	09-1993
"Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994	Phillips et al.	07-1994
"Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002	Narushima et al.	07-2002
"Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999	Minami	07-1999
"Transparent Conducting PbO_2 films prepared by activated reactive evaporation", Phys. Rev. B 33,2660 - 2664 (1986)	D	02-1986
U.S. Patent No. 6,476,788	Akimoto	11-2002
U.S. Patent No. 6,198,091	Forrest et al.	03-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 6-9, 18, 20, 37, 38 and 42-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A) in view of Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002).

Regarding claim 1, Fig. 4 of Hamada et al. discloses a semiconductor device, comprising:

a drain electrode (10);

a source electrode (11);

a channel (8) contacting the drain electrode (10) and the source electrode (11), wherein the channel includes one or more compounds of the formula $A_xB_xO_x$, wherein the compound is ITO (the material comprising 8 is disclosed to be ITO (InSnO));

a gate dielectric (3) positioned between a gate electrode (9) and the channel (8).

Hamada et al., however, fails to disclose that compounds include gallium-tin oxide or that the compounds forming the channel region include one of an amorphous form and a mixed-phase crystalline form or that each x in the formula $A_xB_xO_x$ is independently a non-zero number.

Phillips et al. teaches the use of $GaIn_{1-x}Sn_xO_3$ (wherein each x in the formula is a non-zero number) (Page 115, Bridging Paragraph) as a replacement for a layer of ITO.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the $GaIn_{1-x}Sn_xO_3$ layer of Phillips et al. into the device of Hamada et al. The ordinary artisan would have been motivated to modify Hamada et al. in the above manner for the purpose of further lowering the conductivity of the transparent oxide semiconductor channel region of Hamada et al. and increasing the transparency of the transparent oxide semiconductor channel region. (Hamada et al., Paragraph 25) (Phillips et al., Page 117, Final Paragraph)

Hamada et al. and Phillips et al., however, fail to disclose the channel region including one of an amorphous form and a mixed-phase crystalline form.

Narushima et al. teaches that it is desirable to use amorphous transparent oxide as a semiconductor material (Narushima et al., Col. 1).

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize an amorphous transparent oxide as is taught by Narushima et al. in the device of Hamada et al. and Phillips et al. The ordinary artisan would have been

motivated to modify Hamada et al. and Phillips et al. in the above manner for the purpose of taking advantage of the high electron mobility associated with the amorphous transparent oxides and the ability of amorphous transparent oxides to be deposited on plastic, flexible substrates (Narushima et al., Col. 1).

Regarding claim 2, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 1, wherein the one or more compounds of the formula $A_xB_xO_x$ includes an atomic composition of metal (A)-to-metal (B) ratio of A:B, wherein proportions of A and B, based on stoichiometric x values associated with A and B are in a range of about .05 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

Regarding claim 6, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 1, wherein the one or more compounds of the formula $A_xB_xO_x$ includes C_x, wherein C is Indium ($GaIn_{1-x}Sn_xO_3$)(Phillips et al., Page 115, Bridging Paragraph)

Regarding claim 8, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 6, wherein the one or more compounds of the formula $A_xB_xC_xO_x$ is gallium-indium-tin oxide (Phillips et al., Page 115, Col. 2, Top Paragraph).

Regarding claims 7 and 9, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor devices of claims 6 and 8, wherein the one or more compounds of the formula $A_xB_xC_xO_x$ includes an atomic composition of metal (A)-to-metal (B)-to-metal (C) ratio of A:B:C, wherein proportions of A, B and C, based on stoichiometric x values associated with A, B and C are in a range of about .05 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

Regarding claim 18, Hamada et al., Phillips et al. and Narushima et al. disclose a semiconductor device, comprising:

a drain electrode (Hamada et al., Fig. 4 (10));

a source electrode (Hamada et al., Fig. 4 (11));

means for controlling current flow (Hamada et al., Fig. 4 (8)) to electrically coupled to the drain electrode (Hamada et al., Fig. 4 (10)) and the source electrode (Hamada et al., Fig. 4 (11)), wherein the means for controlling current flow (Hamada et al., Fig. 4 (8)) includes one or more compounds of the formula $A_xB_xO_x$, wherein the one or more compounds includes gallium-tin oxide ($GaIn_{1-x}Sn_xO_3$)(Phillips et al., Page 115, Bridging Paragraph), each x is a non-zero number (Phillips et al., Page 115, Bridging Paragraph) wherein the channel includes an amorphous form (Narushima et al., Col. 1); and

a gate electrode (Hamada et al., Fig. 4 (9)) separated from the channel (Hamada et al., Fig. 4 (8)) by a gate dielectric (Hamada et al., Fig. 4 (3)).

Regarding claim 20, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 18, wherein the source (Hamada et al., Fig. 4 (11)), drain (Hamada et al., Fig. 4 (10)), and gate (Hamada et al., Fig. 4 (9)) electrodes include a substantially transparent material (ITO).

Regarding claim 37, Hamada et al., Phillips et al. and Narushima et al. disclose a semiconductor device formed by the steps, comprising:

providing a drain electrode (Hamada et al., Fig. 4 (10));

providing a source electrode (Hamada et al., Fig. 4 (11));

depositing a channel (Hamada et al., Fig. 4 (8) including a composition (composition including one or more precursor compounds that include A_x and one or more compounds that include B_x, wherein each A is Gallium, and B is Sn)(Phillips et al., Page 115, Bridging Paragraph) to form a multicomponent oxide ($GaIn_{1-x}Sn_xO_3$)(Phillips et al., Page 115, Bridging Paragraph), (each x is a non-zero number (Phillips et al., Page 115, Bridging Paragraph)), wherein the channel includes an amorphous form (Narushima et al., Col. 1)) from the composition to electrically couple the drain electrode (Hamada et al., Fig. 4 (10)) and the source electrode (Hamada et al., Fig. 4 (11)) (see Fig. 4 of Hamada et al.);

providing a gate electrode (Hamada et al., Fig. 4 (9)); and

providing a gate dielectric (Hamada et al., Fig. 4 (3)) positioned between the gate electrode (Hamada et al., Fig. 4 (9)) and the channel (Hamada et al., Fig. 4 (8)).

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al. and Narushima et al.

Regarding claim 38, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 37.

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Narushima et al. and Phillips et al. (See rejection of claim 6 above, wherein the combination of Hamada et al., Narushima et al. and Phillips et al. is shown to disclose GaSnInO).

Regarding claim 42, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 37, wherein providing the source (Hamada et al., Fig. 4 (11)), the drain (Hamada et al., Fig. 4 (10)), and the gate (Hamada et al., Fig. 4 (9)) electrodes includes providing a substantially transparent form of the source, the drain, and the gate electrodes (ITO).

Regarding claim 43, the claim to providing a liquid form of the precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a liquid form of the precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al. and Narushima et al.

Regarding claim 44, the claim to an ink-jet deposition technique for forming the channel is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular ink-jet deposition technique for forming the channel is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al. and Narushima et al.

Claims 10-13 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A), Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) and Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) as applied to claims 1, 6, 37 and 38 above, and further in view of Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999).

Regarding claim 10, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 6, but fail to specifically disclose the limitations added by claim 10.

Phillips et al., however, does disclose that both GaGeInO and GaInSnO are transparent conducting oxides with desirable properties (more transparent then other known TCOs).

Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Minami into the devices of Hamada et al., Phillips et al. and Narushima et al. and combine the GaGeInO and GaInSnO of Phillips et al. to form a new multicomponent oxide. The ordinary artisan would have been motivated to modify Hamada et al., Phillips et al. and Narushima et al. in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the

channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion).

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 12, Hamada et al., Phillips et al., Narushima et al. and Minami disclose the semiconductor device of claim 1, wherein the one or more compounds of the formula $A_xB_xO_x$ is gallium-indium-germanium-tin oxide (combination of GaInSnO and GaGeInO would result in GaInGeSnO).

Regarding claims 11 and 13, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 39, Hamada et al., Phillips et al., Narushima et al. and Minami disclose the semiconductor device of claim 38.

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al., Narushima et al. and Minami (See rejection of claim 10 above, wherein the combination of Hamada et al., Phillips et al., Narushima et al. and Minami is shown to disclose GaInGeSnO).

Claims 14-17 and 40-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada et al. (Japan Patent # JP405251705A), Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994), Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002), and Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999) as applied to claims 10 and 39 above, and further in view of D ("Transparent Conducting PbO_2 films prepared by activated reactive evaporation", Phys. Rev. B 33,2660 - 2664 (1986)).

Regarding claims 14 and 16, Hamada et al., Phillips et al., Narushima et al. and Minami disclose the semiconductor device of claims 1 and 10, but fail to disclose the

one or more compounds of formula $A_xB_xC_xD_xO_x$ including E_x, to form a compound of the formula $A_xB_xC_xD_xE_xO_x$, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each O is atomic oxygen, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different.

D discloses a transparent conductive oxide semiconductor of PbO_2.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the PbO_2 of D into the device of Hamada et al., Phillips et al., Narushima et al. and Minami and combine the PbO_2 of D into the GaGeInSnO of Hamada et al., Phillips et al., Narushima et al. and Minami to form a new multicomponent oxide (GaGeInSnPbO). The ordinary artisan would have been motivated to modify Hamada et al., Phillips et al., Narushima et al. and Minami in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion). The ordinary artisan would have expected a reasonable degree of success in this combination because Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify

the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claims 15 and 17, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 40, Hamada et al., Phillips et al., Narushima et al., Minami and D disclose the semiconductor device of claim 39, wherein the one or more precursor compounds includes one or more precursor compounds that include E_x, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different (See rejection of claims 14 and 16 above, wherein the combination of Hamada et al., Phillips et al., Narushima et al., Minami and D is shown to disclose GaInGeSnPbO).

The claim to providing a precursor composition is a product by process limitation and is given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). The particular process of providing a precursor composition is

therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al., Narushima et al., Minami and D (See rejection of claims 14 and 16 above, wherein the combination of Hamada et al., Phillips et al., Narushima et al., Minami and D is shown to disclose GaInGeSnPbO).

Regarding claim 41, the claims to a method wherein depositing the channel includes vaporizing the precursor composition to form a vaporized precursor composition, and depositing the vaporized precursor composition using a physical vapor deposition technique including one or more of dc reactive sputtering, rf sputtering, magnetron sputtering, ion beam sputtering are product by process limitations and are given no patentable weight so long as the final product of said claim is the same as or obvious over the prior art. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). This particular process of vaporizing the precursor composition to form a vaporized precursor composition, and depositing the vaporized precursor composition using a physical vapor deposition technique including one or more of dc reactive sputtering, rf sputtering, magnetron sputtering, ion beam sputtering is therefore irrelevant given that the final product of the claim is anticipated by Hamada et al., Phillips et al. and Narushima et al.

Claims 48-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A) in view of Phillips et al. ("Transparent Conducting Thin Films of

$GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994) further in view of Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002).

Regarding claim 48, Figs. 1-3 of Akimoto discloses a display device, comprising:

a plurality of pixel devices (Akimoto, Col. 5, Lines 15-21) configured to operate collectively to display images (Akimoto, Col. 5, Lines 48-54), where each of the pixel devices includes a semiconductor device 28 (Akimoto, Col. 5, Lines 15-21) configured to control light emitted by the pixel device (see Fig. 2 of Akimoto), the semiconductor device including:

a channel (300) contacting a drain (4, 5) and a source (2, 3);

a gate electrode (1); and

a gate dielectric (12) positioned between the gate electrode (1) and the channel (300) and configured to permit application of an electric field to the channel (see Fig. 3C of Akimoto).

Akimoto, however, fails to disclose the specifics of the semiconductor device as are claimed.

Hamada et al. teaches a similar semiconductor device wherein a semiconductor device in a display device includes a drain electrode 10, a source electrode 11, a channel (8) contacting the drain electrode (10) and the source electrode (11), wherein the channel includes one or more compounds of the formula $A_xB_xO_x$, wherein the one or more compounds includes ITO (InSnO)), a gate electrode 9, and a gate dielectric 3

positioned between the gate electrode 9 and the channel 8 and configured to permit application of an electric field to the channel (see Fig. 4 of Hamada et al.).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the specific properties of the device of Hamada et al. into the device of Akimoto. The ordinary artisan would have been motivated to modify Akimoto in the above manner for the purpose of building a switching device for driving a photoelectric transducer wherein the properties of said device are not influenced by light (Paragraph 1, Hamada et al.).

Akimoto and Hamada et al., however, fail to disclose that compounds include gallium-tin oxide or that the compounds forming the channel region include one of an amorphous form and a mixed-phase crystalline form or that each x in the formula $A_xB_xO_x$ is independently a non-zero number.

Phillips et al. teaches the use of $GaIn_{1-x}Sn_xO_3$ (wherein each x in the formula is a non-zero number) (Page 115, Bridging Paragraph) as a replacement for a layer of ITO.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the $GaIn_{1-x}Sn_xO_3$ layer of Phillips et al. into the device of Akimoto and Hamada et al. The ordinary artisan would have been motivated to modify Akimoto and Hamada et al. in the above manner for the purpose of further lowering the conductivity of the transparent oxide semiconductor channel region of Akimoto and Hamada et al. and increasing the transparency of the transparent oxide semiconductor channel region. (Hamada et al., Paragraph 25) (Phillips et al., Page 117, Final Paragraph)

Akimoto, Hamada et al. and Phillips et al., however, fail to disclose the channel region including one of an amorphous form and a mixed-phase crystalline form.

Narushima et al. teaches that it is desirable to use amorphous transparent oxide as a semiconductor material (Narushima et al., Col. 1).

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize an amorphous transparent oxide as is taught by Narushima et al. in the device of Akimoto, Hamada et al. and Phillips et al. The ordinary artisan would have been motivated to modify Akimoto, Hamada et al. and Phillips et al. in the above manner for the purpose of taking advantage of the high electron mobility associated with the amorphous transparent oxides and the ability of amorphous transparent oxides to be deposited on plastic, flexible substrates (Narushima et al., Col. 1).

Regarding claim 49, Akimoto, Hamada, Phillips et al. and Narushima et al. disclose the display of claim 48, wherein the source (11), drain (10), and gate (6) electrodes include a substantially transparent material (ITO) (see Fig. 4 of Hamada et al. for citations).

Regarding claim 50, Akimoto, Hamada, Phillips et al. and Narushima et al. disclose the device of claim 48, wherein the one or more compounds of the formula $A_xB_xO_x$ includes an atomic composition of metal (A)-to-metal (B) ratio of A:B, wherein proportions of A and B, based on stoichiometric x values associated with A and B are in

a range of about .05 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

Regarding claim 51, Akimoto, Hamada, Phillips et al. and Narushima et al. disclose the display of claim 48, wherein the one or more compounds of the formula $A_xB_xO_x$ includes C_x, wherein C is Indium ($GaIn_{1-x}Sn_xO_3$)(Phillips et al., Page 115, Bridging Paragraph)

Regarding claim 52, Akimoto, Hamada et al., Phillips et al. and Narushima et al. disclose the device of claim 51, wherein the one or more compounds of the formula $A_xB_xC_xO_x$ includes an atomic composition of metal (A)-to-metal (B)-to-metal (C) ratio of A:B:C, wherein proportions of A, B and C, based on stoichiometric x values associated with A, B and C are in a range of about .05 to .95 (Phillips et al. discloses $GaIn_{1-x}Sn_xO_3$ (0<=x<=20), which satisfies the limitations of this claim).

Claims 53 and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788) in view of Hamada et al. (Japan Patent # JP405251705A), Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994), Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002) as applied to claims 48 and 51 above, and further in view of

Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999).

Regarding claim 53, Akimoto, Hamada et al., Phillips et al. and Narushima et al. disclose the semiconductor device of claim 51, but fail to specifically disclose the limitations added by claim 53.

Phillips et al., however, does disclose that both GaGeInO and GaInSnO are transparent conducting oxides with desirable properties (more transparent then other known TCOs).

Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Minami into the devices of Akimoto, Hamada et al., Phillips et al. and Narushima et al. and combine the GaGeInO and GaInSnO of Phillips et al. to form a new multicomponent oxide. The ordinary artisan would have been motivated to modify Akimoto, Hamada et al., Phillips et al. and Narushima et al. in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion).

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233

(CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 54, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Claims 55 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akimoto (U.S. Patent # 6476788), Hamada et al. (Japan Patent # JP405251705A), Phillips et al. ("Transparent Conducting Thin Films of $GaInO_3$", Appl. Phys. Let. Vol. 65 (1), July 1994), Narushima et al. ("Electronic structure and transport properties in the transparent amorphous oxide semiconductor 2 CdOGeO", Phys. Rev. B 66, 035203-1, 7/16/2002), and Minami ("Transparent and Conductive Multicomponent Oxide films prepared by magnetron sputtering", Minami, J. Vac. Sci. Technol. A 17(4), Jul/Aug 1999) as applied to claim 53 above, and further in view of D ("Transparent Conducting PbO_2 films prepared by activated reactive evaporation", Phys. Rev. B 33,2660 - 2664 (1986)).

Regarding claim 55, Akimoto, Hamada, Phillips et al., Narushima et al. and Minami disclose the semiconductor device of claim 53, but fail to disclose the one or more compounds of formula $A_xB_xC_xD_xO_x$ including E_x, to form a compound of the formula $A_xB_xC_xD_xE_xO_x$, wherein each E is selected from the group of Ga, In, Ge, Sn, Pb, each O is atomic oxygen, each x is independently a non-zero number, and wherein each of A, B, C, D, and E are different.

D discloses a transparent conductive oxide semiconductor of PbO_2.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the PbO_2 of D into the device of Akimoto, Hamada, Phillips et al., Narushima et al. and Minami and combine the PbO_2 of D into the GaGeInSnO of Akimoto, Hamada, Phillips et al., Narushima et al. and Minami to form a new multicomponent oxide (GaGeInSnPbO). The ordinary artisan would have been motivated to modify Akimoto, Hamada, Phillips et al., Narushima et al. and Minami in the above manner for the purpose of creating a new multicomponent oxide suitable for use as the channel of a switching device employed for use in a light emitting system because of its specific electrical, optical and chemical properties and its specific bandgap energy and workfunction, which can be controlled by altering the chemical composition (Minami, Conclusion). The ordinary artisan would have expected a reasonable degree of success in this combination because Minami teaches that a transparent conducting oxide will always be obtained when combining oxides which are TCO film materials or transparent conductors.

The claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

Regarding claim 56, the claims to a specific composition ratio of the claimed compound are considered to be an optimization of ranges. *In re Aller, Lacey, and Hall*, 105 USPQ 233 (CCPA 1955). It would have been obvious to one of ordinary skill in the art to modify the composition ratio of the claimed composition to form a composition with properties ideal for use as the channel of a switching device employed for use in a light emitting system (i.e., workfunction and transparency).

(10) Response to Argument

Appellant argues that the combination of Hamada et al. and Phillips et al. "fails to teach or suggest the claimed channel "wherein the one or more compounds of the formula $A_xB_xO_x$ includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-germanium oxide, indium-lead oxide."", arguing that Phillips et al. only discloses "gallium-indium-tin oxide or gallium-indium oxide".

The Examiner argues that the limitation in question is open-ended, and the compounds ($A_xB_xO_x$) referred to therein can contain other elements (i.e., the gallium-tin

oxide ($A_xB_xO_x$) referred to in claim 1 can, within the scope of the claim, contain indium, thus forming gallium-indium-tin oxide ($A_xB_xC_xO_x$)). It has been held that the use of the term "comprising" leaves a claim open for inclusion of unspecified ingredients other than recited in the claims, **even in major amounts**. *Ex parte Davis*, 80 USPQ 448 (PTO Bd. App. 1948).

The Examiner further points to the instant claims 6 and 51 *(which both state "wherein the one or more compounds of the formula $A_xB_xO_x$ includes C_x, to form a compound of the formula $A_xB_xC_xO_x$)*. It is clear from these claims, which depend from, and refer back to claims 1 and 48, that the limitation "one or more compounds of the formula $A_xB_xO_x$" is intended to be open-ended and can therefore be reasonably interpreted to include compounds of the formulae $A_xB_xC_xO_x$ such as gallium-indium-tin oxide. The Examiner further notes that instant claims 10 and 53 *(which both state "wherein the one or more compounds of formula $A_xB_xC_xO_x$ includes D_x, to form a compound of the formula $A_xB_xC_xD_xO_x$)* and the instant claims 14 and 55 *(which both state "wherein the one or more compounds of formula $A_xB_xC_xD_xO_x$ includes E_x, to form a compound of the formula $A_xB_xC_xD_xE_xO_x$)* contain similar limitations.

Appellant further argues that "the x given in the formula $GaIn_{1-x}Sn_xO_3$ (of Phillips et al.) be the same for both instances of "x"". Placing the formula of Phillips into the same format as the formula given in the instant claims yields $Ga_xSn_xIn_{1-x}O_x$, wherein Ga is equivalent to A, Sn is equivalent to B, and In is equivalent to C (from instant claims 6 and 51) wherein the value of "x" associated with Ga is 1, wherein the value of "x" associated with O is 3, wherein the value of "x" associated with Sn remains as x

(wherein x is defined as 0≤x≤.20) and wherein the value of "x" associated with In ("x" is denoted as 1-x in Phillips et al.) is 0.8≤x≤1. Thus, the Examiner argues that in the formula given by Phillips et al., it is clear that all values of "x" can be non-zero numbers, and further, that the value of "x" for each constituent element may be different.

Lastly, Appellant argues that one of ordinary skill in the art would not have reasonably replaced a "semiconducting ITO layer" with "some other transparent conducting material that is equivalent to ITO in an entirely separate use and context. The Examiner argues that one of ordinary skill in the art, combining Harada et al. and Phillips et al. would have known that transparent conducting oxides (including GaInSnO (GITO) and ITO) exhibit semiconductive properties, and thus would not have been deterred from making the combination. Forrest et al. (U.S. Patent # 6198091) provides evidence that GITO and ITO are known in the art to be transparent conducting oxides exhibiting semiconductive properties (Forrest et al., Col. 5, lines 25-40).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

William F. Kraig

/William F Kraig/

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